ACTA DIDACTICA NAPOCENSIA

Volume 9, Number 4, 2016

SECONDARY CHEMISTRY SCHOOL TEACHERS WORKING IN TERTIARY EDUCATION CHEMISTRY DEPARTMENTS; CRITICAL REFLECTIONS ON THE POSITIVES AND NEGATIVES

S.R. Glover, T.G. Harrison, D.E. Shallcross

Abstract: Several UK University Chemistry Departments have former secondary school chemistry teachers employed as School Teacher Fellows (STF) who are heavily involved in outreach work and a range of teaching responsibilities. This study looks at the outreach role from the point of view of several of the STFs; the benefits, and the barriers and how this role can be developed further. A reflective exercise, asking STFs to write a letter to themselves to advise any new incumbent was used to generate data. This mode was preferred to a formal interview after consultation with STFs. All the responses were analysed in terms of their relationships, motivations and other aspects of their posts. It is concluded that the STF provides a number of unique opportunities to progress relationships between university and secondary and primary schools, to assist new undergraduates in making an effective transition from post-16 study to undergraduate study and to review, support and progress teaching practice at tertiary level. However, barriers to the effective utilisation of STFs include; appropriate support and recognition at the tertiary institute and funding.

Key words: chemistry outreach, school–university relationships, communities of practice, school teacher fellows.

1. Introduction

In this study we define a School Teacher Fellow (STF) as a qualified and experienced secondary school chemistry teacher who has been seconded to work within a UK universities' chemistry department for a period of time, usually for a year or more [1-7]. In general, the concept of a School Teacher Fellow is not confined to a particular subject and could involve a primary school teacher working in a secondary school or tertiary (Higher Education) institute or a secondary school teacher working in a primary school. The general concept being that an educator from one phase of the education system works in another phase of the system and shares best practice and acts as a conduit for educators like themselves. In this way, barriers to transition from primary to secondary (e.g. [8-10]) and secondary to tertiary (e.g. [11-12]) can be addressed. It is also perfectly possible for tertiary educators to also work in primary and secondary schools, but a lack of a formal teaching qualification may preclude such a transition in many cases (at least in the UK where Qualified Teacher Status is usually required).

Shallcross et al., [3] compare the current STF programme with a UK initiative from around 2000 called the Excellence Fellowship and discuss the motivations for a teacher to want to take on a STF role and why the initial scheme was not successful. A key area for the paucity of success of the Excellence Fellowship was facilitation of a relationship between the host Higher Education department and the STF and the provision of support and recognition of the skills being provided by the STF. There are myriad motivations to become a STF and these are discussed in detail [3] but prominent ones are; re-energization of experienced teachers, an opportunity to engage with post-18 students and academics, develop new skills, update subject knowledge, familiarization with current ways of teaching at Higher Education level, etc.

In this study the STF in Chemistry role was pioneered by the School of Chemistry at the University of Bristol UK under the auspices of the Centre for Excellence in Teaching and Learning initiative called Bristol ChemLabS [1, 6, 7] established in 2005. The Bristol STF initiative (a secondary school teacher

Received May 2016.

working in a higher education institute) was so successful that the Royal Society of Chemistry funded STF positions at other universities, initially, as part of the 'Chemistry for our Futures' Programme [2, 13-15]. The Chemistry School Teacher Fellows (STFs) in the UK have been involved in various projects including science outreach to primary and secondary schools and colleges, as well as teacher training, university recruitment and advising tertiary institutions on the teaching of undergraduates. The foundational concept of the role is to, 'make use of the resources of a university chemistry department to promote chemistry regionally, nationally and internationally through a wide variety of activities' [2-5]. The specific activities vary from institution to institution but have generally included lectures and lecture demonstrations (both at schools and at the university) and workshops and practical activity provision for school pupils and teachers offered at universities and making use of chemistry laboratory space [16-21]. In addition STFs have developed and facilitated workshops in primary and secondary schools and colleges, offered teacher and technician training and been involved in the training of university students in the soft skills needed for science communication in both oral and written forms. They may also work in an advisory capacity with university academics and teaching staff to improve teaching and learning and enable a smooth transition between A-level and first year at university [1-7, 16-21]. Several STFs have published in journals and teaching periodicals as outreach evaluation has led to education research [3 and references therein]. In this UK example, STFs have been incorporated into University departments in different ways (see [3] for details) with differing duties. In general, all STFs have contributed to undergraduate teaching in some way (e.g. first year courses and also school-based final year projects), either directly or in an advisory role and most have contributed to outreach to schools and the general public and in many cases led that activity. Where STFs have become permanent members of staff they have occupied senior positions, e.g. Reader (senior lecturer) and most recently at Professorial level.

2. The research undertaken

2.1 Context for the research

There is documented evidence of the success of the STF initiative in the various institutes where they were deployed in terms of smoothing the transition from secondary to tertiary and in general breaking down barriers across this educational divide [3, 17, 19-23]. The role and the relationships developed between STFs and other teachers and Higher Education Institution staff has not been examined. This study examines in detail the role of the STF and whether the unique position is well utilised in order to develop the relationships that are so highly valued by the secondary teachers. Indeed the questions this study seeks to answer are;

a. How does the role and unique position of the school teacher fellow facilitate the interaction of secondary and tertiary institutions?
b. How is the role perceived by the school teacher fellows themselves?

2.2 Methodology employed

Questionnaires have been used to study relationships between school teachers (e.g. Cohen, 2007 [24]) and a preliminary questionnaire was trialled with two STFs. However, the final research methodology employed was qualitative, employing a reflective exercise, asking STFs to write a letter to themselves to advise any new incumbent. The STFs who were involved in the trail questionnaire advised that this would be a much richer method of gathering information on the STFs' feelings and perceptions. Asking the STFs direct questions about their relationships and experiences in their position would not have elicited such a rich description of role, insight into the local circumstances and relational aspects.

2.3 Data analysis

Data analysis was thematic. The School Teacher Fellow letters to self were analysed by highlighting any mention of relationship dynamics between STFs and teachers as well as STFs and university staff and/or academics. Particular attention was also paid to instances where the STFs speak about the peculiarities of their role as a secondary school teacher in a tertiary setting. These aspects are important to understand STFs as the face of the tertiary institution and the bridge or access point to the HEI for teachers from a secondary background. Braun and Clarke's [23] description of thematic analysis was used to examine the STF data. The STF data was coded using a theoretical approach as these data were examined to look for instances of relationship and power dynamics between the STFs and teachers, and the STFs and the HEI. The approach used to analyse these data was concept driven (theoretical) rather than data driven (inductive). However, the analysis was conducted with an emphasis on a rich description of the data and the aim of identifying themes and patterns from the data within the context of awareness of relationships and power dynamics between people [23-27].

2.4 The sample

Seven people took part in the sample working in 7 different UK HEIs as chemistry outreach coordinators (6), 5 of whom as STFs (i.e. have been secondary school chemistry teachers), and one who is not a qualified secondary school teacher but fulfils the same role were contacted. In addition, an academic heavily involved in outreach and pioneering outreach amongst academics and postgraduates in the chemistry-related department at a university that has never had a STF was also interviewed to understand how outreach works in that context and whether he faces some of the same challenges.

Therefore, the sample consisted of 4 current School Teacher Fellows, 1 former STF, one current outreach worker who is not a trained secondary teacher, known as a Public Awareness Scientist, and the academic at an institution with no STF or history of outreach in chemistry. Table 1 shows these professionals with their year of appointment. The Public Awareness Scientist (PAS) has been employed in their position for the longest time, and their appointment was made before the Bristol STF programme began [1]. STF 2- 4 were all funded either completely or in part by the Royal Society of Chemistry 'Chemistry for our Future (CFOF)' programme [2, 13-15]. The academic was not appointed to do outreach, therefore the appointment date is of no consequence, but they become involved in outreach partly as a result of seeing the success of the Bristol ChemLabS outreach programme.

Table 1: *School Teacher Fellows and other staff with their year of appointment*.

School Teacher Fellows	Year of Appointment
STF 1	2006/2007
STF 2	2007/2008
STF 3	2007/2008
STF 4	2008/2009
Public Awareness Scientist (PAS)	2004/2005
Former STF	2011/2012
Academic	1999

2.5 Ethical considerations

Ethically, working with the STFs presented a challenge as they are public figures and the institutions that employ them are in the public domain. Sensitivity in describing them and their institutions is thus of the utmost importance in preserving their anonymity. Great care has been taken to ensure that particular responses, while unavoidably identifiable to one of 7 people, cannot be linked to a particular STF or institution.

2.6 Research instruments and data collection

The STFs completed a reflective exercise rather than an interview. The STFs were asked to write a one to two page letter to their school teacher selves, as if they were just about to take up the STF position. As examples of things to write about they were given the following broad guidelines, '…give your past-self advice about how to go about doing things, what worked, didn't work, what to hold on to, what will motivate you and anything else you wish you'd known back then, such as the problems you will face and how to overcome them…'

The chief aim was to examine the interpersonal relationships between the STF and the chemistry department and whether the STFs felt that their university had a good grasp of what an STF actually does, and how they experience outreach work. How the position is currently funded was also of interest, as all the original positions came with funding for a finite time, from various donors, including the RSC Chemistry for our Future campaign, but they are no longer funded in this way [2]. The STF as the pivot around whom outreach takes place, is highly valued by school teachers who invest in and value the relationship they have with them often highlighting this as a reason for repeat engagement [28]. It was of interest to discover whether the STFs were aware of their importance in this area and whether they mentioned investing in relationships in their advice to themselves.

3. Results and discussion

Aside from the importance of relationships, the STFs' motivations, their advice to themselves on managing their time and developing resources is also discussed. The results are addressed by theme.

3.1 Relationships

The importance of relationships and the need to develop connections with key people was mentioned in some form by every STF. STF 2 summed it up by saying, 'It all hinges on genuine, sincere relationships with teachers and [university] staff.' The STFs' mention of relationships take a few different forms: relationship with those inside the university (staff and students), relationships with other STFs at other HEIs and relationships with students and teachers at schools.

3.1.1 Relationships within the HEI

These were further broken down into sub-categories: supportive relationships and those that are challenging.

3.1.1.1 Supportive relationships

There was a clear focus on the importance of developing relationships and connections with people within the HEI, such as technicians, who are essential in order for the STF to be able to do their jobs well.

'You know as a school teacher that a good technician is worth their weight in gold. This is no different at university but you will have to work with many more of them, each with their own speciality. So I would encourage you to go out of your way to forge friendships. Invite them to sit down with you and

have a coffee, listen to their gripes and go out of your way to thank them whenever they help you out. Do it in person on the day and follow it up with an email. They will really appreciate you taking the time (STF 4).'

Similarly STFs mention the need to identify key people within the HEI who are able to support them practically and in their role, particularly those who value the outreach that they are doing.

'You will find a few good academics and you will work with them (STF 2).'

STF 4 mentions the importance of making connections with those in the university responsible for liaison and administration,

'Find out as much about the administrative process for liaison at your university and then use their expertise to make contacts both inside and outside the university. Again don't forget to thank them in person and via email,' as well utilising the expertise of technicians in delivering outreach activities particularly to school technicians, 'and if you can involve the university technicians as deliverers all the better. They will love to share technician's tips and it will be a good experience for them both.'

The former STF also described the value of their relationship with two teaching fellows in the HEI chemistry department, 'there were two Teaching Fellows who turned into excellent friends/colleagues and were definitely my first port of call with questions, discussions etc. They were interested in the way the students learnt and what understanding the students had from A-level and so we would interact both ways fairly frequently.'

3.1.1.2 Challenging relationships

It is clear from the way that STFs and the PAS write to themselves, that they were all concerned about working in a tertiary environment with academics and researchers when they began their roles. This lends credence to the idea that there is a significant barrier to overcome for secondary teachers in working with and gaining access to a university. The STF (as a teacher) must also overcome this barrier to an extent and this is what makes them so helpful to teachers in their role as STFs. The STFs show in their responses that these concerns were not entirely unfounded although there were academics and HEI staff who did see the expertise and knowledge that they had to offer,

'Don't worry about working with academics – it won't take long before they appreciate your own expertise (STF 1).'

'Your perception of academics may be that they are unlikely to be receptive to new ideas from outsiders. Although this may be true to an extent, the reality is that if you earn their trust, they really will take on board what you have to say (STF 3).'

This idea of needing to earn the trust of academics comes up in the former STF's letter as well as the letter of STF 3. The other STFs while not using the word 'trust' in their letters, do speak about it taking time for their role to settle, both for them and for the staff and academics of the HEI. Every STF letter, apart from STF 1, mentions that there are those who are supportive and those who are not. The academic who has started up an outreach programme in chemistry at his HEI was very vocal about the opposition that he faces, and he did not have the added complication of being a teacher coming into the HEI from the outside. He mentions having to prove through his publication record and his postgraduates' success that outreach does not detract from research or productivity but rather encourages it, but he says, 'no matter what argument I use, in terms of productivity or whatever, no one will listen. It is a pure control issue with supervisors.' This shows that the barriers the STFs face in doing outreach and gaining support from their institutions are more complex than they may first appear. While the secondary/tertiary divide is a factor, it is not the only cause for difficulty. There are those in every institution who do not support outreach in chemistry and are actively hostile, and equally there are those who, 'like to generate ideas,' but 'won't help you do anything (STF 2).'

The STFs encourage a focus on working with the supportive people, leaving those who are not interested alone. 'Your strength may be sapped by academics…some of them will simply not care…they just want to publish papers…that is fine, leave them to get on with that. You have to go to

work for the kids and never mind the politics and postulating you will observe. You will find a few good academics and you will work with them. Trust me! (STF 2).'

'You will feel scared and in a strange way homesick for your previous workplace, and at the very worst of times, inferior. Not only are you a new person, an unknown quantity, but you'll also be in a role that no one else has occupied, and your colleagues will be weighing you up and trying to get the measure of you. A few will never participate in outreach, and that is fine; if it's not something they want to do, then don't try to force them to. All that achieves is conflict and strife for you, and the potential disaster of an audience faced with a speaker who is unenthusiastic…ignore the naysayers (PAS).'

These illuminating comments, especially the one from the Public Awareness Scientist, a research scientist with a doctoral degree, imply that there are those within HEIs who do not see the value of outreach activities and engagement with those outside the tertiary sector and are not supportive, or may be hostile, even to someone who could be considered one of their own. The former STF, also a PhD chemist, mentioned a similar feeling, 'I was surprisingly very nervous interacting with the academic staff as I didn't feel my subject knowledge was up there (I have a PhD from Cambridge and was a Research Fellow before moving into teaching so this surprised me).' In their case they felt that the academics were receptive to them, despite their nervousness regarding their own teaching but that as the position was only for a year, it was not long enough to establish the depth of relationship needed to become a true part of the department, 'Similarly I think the academics were nervous of me and concerned about the quality of their teaching. Initially trying to break down these barriers was difficult but I think by the end a trust had been reached. Having longer than a year and being seen as a permanent member of staff would have helped on this front.' As they were the only former STF to respond to the request to complete the reflective exercise, it is not possible to say whether other short term STFs encountered the same problems, but since those still in STF positions report similar initial problems, and also report a transition in their relationships with the academic staff at their institutions over time, this appears to confirm the former STF's hunch that these problems may have been overcome if given a longer period of time in the position. However, the long term STFs and the PAS have had the realisation that some people would never be interested, and have made their peace with this so it seems that when the challenge is largely related to STFs perceptions of themselves in relation to academia, this can be overcome over time, probably through a similar process of active empowerment as the secondary teachers experience. The STF becomes settled in their position and their expertise is both recognised and utilised by the staff at the HEI. In contrast, where an academic staff member is not open to outreach as a concept, none of the STFs have been successful in 'converting' them, preferring to work with those who have shown an interest and developing relationships where trust was built up over time.

3.1.1.3 Relationships with students and outreach volunteers

This aspect of STF interaction within the tertiary environment was mentioned by three of the STFs as well as the academic. STF 2 mentioned their belief that volunteering, rather than paid work for students was the way to get the best helpers. They saw inspiring them and showing them the value of education as a key part of his STF mandate, 'Remember that working with school students is inspiring for [university students] too and might make some of them go on to become teachers.' STF 4 saw that undergraduate and postgraduate students were an important resource to tap as they could appeal to school children in a different way than they could. They valued their relationships here as they could take them with them when visiting schools saying, '…go out to the school and take someone with you – an undergraduate can empathise with the children as they are not that much older and can sometimes allay the fears of prospective students.' STF 1 was concerned going into the position that they might lose the kind of teacher-student relationships he had enjoyed, but then found that this rapport developed with the 'myriad of postgraduates and undergraduates' he regularly worked with. Similarly, the former STF found their final year project students and first year tutorial group helped them feel connected to the teaching staff of the department as well as facilitated student interaction that helped them to do their job. As they were tasked with focusing on the transition from school to university,

these consistent chances to meet and get to know students helped them to 'learn first-hand the challenges they faced on the transition.'

3.1.2. Relationships with other School Teacher Fellows

A couple mentioned the importance of making and maintaining connections with the other active STFs. 'Make a point of getting together with the RSC STFs still based in universities – they will be pleased to share their experiences and expertise with you (STF 4).' 'It is vital that you hit the road and visit colleagues in other universities regularly (STF 3).' STF 2 notes that while the other STFs have resources to share, these may need to be adapted, 'Other STF's will give you practical scripts but you will need to make them work where you are.' This implies a sharing of practice, resources and support which is generously given. STF 4 also valued becoming part of the College of STFs, and the support they experienced, saying, '…make as many new contacts as you can. RSCSTF's [STFs sponsored by the RSC] are an amazing bunch of people.' The former STF also used the support of the STFs when the knowledge and resources of their chemistry department were lacking – they needed support in research and reporting – 'The academics were good for scientific research but not so good on educational research i.e. how to set a good questionnaire etc. The other STFs helped hugely with this as did making contact with the Education Department at the University.' The support, regular sharing of good practice and how to overcome common challenges within the STF group is clearly of value. The College of STFs meets annually [1] to facilitate this support and collaboration. It continues to be an important network for the current STFs. The academic, while not part of this group, relied in a similar way on an academic who had started an outreach program sometime earlier when they started outreach at their institution.

3.1.3. Relationships with school teachers and school students

Universities tend to talk about relationships or engagement with schools; STFs prefer to talk about relationships with teachers and their students.

3.1.1.1 School Teachers

While relationships with school teachers were not mentioned by the PAS or academic at all, STFs 2, 3, 4 and the former STF state the importance of these relationships and with advice about developing them, showing that at least some STFs have expressed the value of solid relationships with teachers. STF 4 describes the need to involve teachers and schools in planning and the disappointment they felt when some of them were not interested, 'I would encourage you to personally contact all the Heads of Chemistry/Science at the local schools and go and talk to them in their schools. Tell them what you are aiming to do and hear what the schools would like to get out of the partnership too. But don't beat yourself about the head if they don't want to get involved. It's no good flogging a dead horse. You are better concentrating your energies on the schools that are proactive.' These teachers are active participants in their own and their students' learning. However, passive, disinterested teachers are thus not being reached by STFs, and so many students may be missing out on access to the outreach and developing ways of reaching these teachers may be an important avenue of enquiry. STF 3 mentions the mutually beneficial role that their relationship with school teachers plays: 'Teachers in local schools and colleges will love having someone like you around, and you'll have no shortage of takers for whatever outreach activities you offer,' and acknowledges their own need to remain connected with the teaching profession, 'Another important reason for getting out to schools is to keep you in touch with what brought you here in the first place. To some, a school teacher fellowship might look like an escape from the classroom, but this is not the case. STFs can bridge the gap between schools and universities, but they can only do this if they keep one foot in the classroom. Outreach is one way of doing this, but you will be in a good position to share the good practice you develop and encounter along the way with teachers, who will value your insight and support.' STF 3 realises that to remain relevant to teachers and students, keeping in touch with schools and the way they work, and aware of

challenges teachers face is important. STF 2 acknowledges that it takes time to develop meaningful and mutually beneficial relationships with teachers, writing, 'Be patient, you [will] build up rapport with teachers.' The former STF counted the teacher network they set up as one of the successes of their tenure as an STF. They developed this to facilitate, 'linking chemistry teachers from across the East Midlands. This is still going with a group on myRSC [a 'chat room' within the Royal Society of Chemistry] and an annual meeting in June.' Despite the ending of their time as an STF this relational support network that they developed had been sustained, which shows how powerful beneficial relationships and support networks can be in ensuring longevity and sustainability.

3.1.1.2 School students

These relationships were rarely mentioned, as the STF would ordinarily engage with a particular child at a one-off event. The only exception was STF 2 who stated that, 'you can do lots of cool things for the kids who really matter, the personal recommendation, the girl who is really bright but who has had problems,' but they did not elaborate. STF 1 in contrast wrote that these relationships were replaced by relationships with university students. The nature of outreach events and the job of the STF to reach large numbers of pupils at various times during their school career precludes meaningful relationship with school students even if they are involved more than once in an event. This is different to teachers who may regularly return and are involved in the organisation of events, allowing more meaningful relationships to develop.

3.1.2 Relationships through other networks

Only STF 4 mentions the STEM Ambassador network [29], despite all being known to engage with this organisation, and the wider international science education community, saying that the connection with this wider network makes logistics and safeguarding procedures simple, but also that, 'they may also be able to put you in contact with likeminded academics/students who can be an extra pair of hands for anything you organise,' showing that this connection has helped develop further relationships. While STF 3 says they should 'hit the road' and get out there to network and help with 'maintaining a high profile,' this is more about being valued by their host institution. They say that they feel that this networking with colleagues at other institutions 'will ensure that you continue to be valued by your host institution and will help you to develop your role to become more sustainable in the long-term,' linking external relationships with the sustainability and security of his position. The PAS mentions external relationships less directly, saying, 'You will be the envy of your scientist (and even some non-science) friends, and will get to visit places and meet people from all over the world.' Other than this being part of the enjoyment of their job, these external relationships are not described, they are simply acknowledged.

3.3. Motivations

3.3.1. Social justice concerns

Two STFs, particularly STF 2, have social justice as a major motivation. Since STF 2 was the only STF who mentions relationships with school students, it is clear that this motivation for involvement in outreach in chemistry has given them a different experience, and a slightly different focus, when compared with the other STFs. After mentioning school students they say, 'You have a university chemistry department at your disposal and you can use it to fight social injustice and inspire people to change the course of their whole lives for the better. And that's the point. It's more than just chemistry.' This is an incredibly powerful statement and a hugely important motivator – resulting in important relationships with students and teachers. STF 2 continues, 'All people matter, children from private schools are as important as children from disadvantaged schools and all ages are important. Work with all of them. It is the variety of your work that will appeal to you and keep you energised…Never compromise your values or your standards. Not for anyone. And it is ok to shout at administrators and the bigoted if they aren't listening. You are shouting for the kids who don't get heard.' It is obvious that while social justice concerns are a powerful motivator for STF 2 they have

also brought them into conflict with having a different focus. STF 4 recognises in themselves and the other STFs that, 'like you they have a passion for teaching chemistry and giving children from often very disadvantaged backgrounds a view of a different future which is in their grasp.'

3.3.2. Self-motivation

The former STF and STF 3 both felt they were self-motivated to succeed, 'I am very self-motivated and knew from the outset that this was just a one year opportunity and that I wanted to get something concrete out of it (former STF),' and STF 3 encouraged themselves to take hold of every opportunity in order to have the greatest impact.

3.4. Attitudes towards chemistry and science education

This cohort of Fellows are motivated by their love of teaching [3] and irrespective of their position (school teacher in a higher education institute, a public awareness scientist or even an academic) they love the subject they teach. The PAS is clearly motivated by the joy of the chemistry itself, and being able to share this with others, saying, 'You're going to get to do all of the flashy and exciting experiments that first made you fall in love with chemistry, and better still, you'll get to relive those moments of joy through the faces and reactions of people you'll get to share your passion with. Those moments. That instant when you communicate a scientific concept in the perfect way; the flash of realisation you literally see spreading across a face; the smile that shows you that someone has walked away with a lifelong interest you've awoken in them… these are the moments that will stay with you and these are the most valuable gifts an educator could wish for!' Similarly, STF 1 loves enthusing kids using chemistry, 'isn't having the biggest chemistry kit in the UK to use to enthuse kids sufficient [motivation]?' Like STF 1 and the PAS the academic does outreach because he really enjoys doing it and to, 'get kids interested in [science].' Throughout all the letters there is a passion and love for the subject that they teach. In particular for the school teachers, the opportunity to use and access to resources that are not available in secondary schools is an important re-energization process for them as well as providing outstanding learning opportunities for those they teach.

3.5. Activities of the Teaching Fellows

All the STFs mention the need to manage their time well and carve out time to reflect, plan and trial. Many mention an element of guilt at not 'doing' something all the time, as STF 4 describes, 'you mustn't feel guilty when you have time to sit and read. At school everything is so time constrained that you rarely get the time to really plan things, to trial them and to see them through to completion and fully evaluate them…don't expect to get lots done in the first 3-4 months. It takes that long to make contacts and draw up plans. It's no good doing something in a rush and then finding it doesn't work properly. Much better to trial thoroughly and then execute the plan.' STF 3 says, 'the most important thing you need to do is to learn to say "no" sometimes. The words, "[STF 3's name] could do that," will be uttered over and over again by your colleagues, and it is vital that you protect your time by taking on only those tasks which are central to your objectives in taking on this job. You are starting with a blank sheet and you can make the role into whatever you want it to be. Don't let yourself be railroaded into time-consuming dead ends. Another important reason for saying no from time-to-time is to ensure that you are not constantly run ragged. After years of having your schedule dictated by a school timetable and the ring of a bell, you will be tempted to cram your diary full of exciting appointments and activities. Try not to let that happen! Schedule a day each week in the office so you have time to reflect on your achievements and to plan for the next steps that will help you to make the biggest impact possible.' Like STF 3 and 4, STF 1, 2, the PAS and the former STF all write about scheduling in breaks and time to reflect, making sure not to burn out. This seems to suggest that there is a lot of work generated by outreach involvement and that those in the HEI who understand the purpose and objectives of an STF poorly can make more work for the STFs if the STFs are not careful to protect their time. STF 1 describes the drain that the administration work can be, 'The biggest downer of your working term will all be to do with finance-checking that invoices you have requested be raised and continuously looking for funding sources to support all outreach projects and people… outreach is teaching without marking but still involves paperwork at some point… Expect to work 7

days per week, your 38 hrs per week will easily be done by Wed lunchtime- and expect not to take all your holiday entitlement- you don't need half terms anyway.'

While many of the STFs have generated academic research, and the RSC sponsored STF would have reported to the RSC on their activities, most did not mention anything about publishing and reporting. STF 1 who has been prolifically published did not mention this at all. However, STF 3 and 4 focus on the importance of planning activities and evaluating them well. 'The university will be interested in…evaluation and if you can get the findings published even better (STF 4).' STF 3 discusses this is greater detail showing his development from being unsure of how his insights might be valuable, to realising his career depends on the sharing of his results and really enjoying this aspect of their job. 'Although giving talks at conferences may seem daunting at first, and you may not believe that people will really be interested in what you have to say, this is one of the most enjoyable aspects of the job you will be doing, and it is vital that you get stuck into this as soon as the opportunities arise. You will regularly be asked to produce reports on your work and its benefits. Although this may feel like a burden, it is actually a valuable opportunity. Everything you do, whether it's the trialling of a new teaching approach, or the evaluation of a novel outreach activity, represents a potential piece of research. There are many outlets for the publication of your findings, and papers in high profile education research journals will cement your place in the chemistry education community. In an era where the mantra 'publish or be damned' resonates all over academia, this could be a fruitful strand of your activity…you will need to be able to demonstrate some impact in terms of recruitment to satisfy the paymasters!'

Creating lecture demonstrations and developing activities for children to do is an important part of the job of the STF, the academic and the PAS. Most STFs suggest getting activities to adapt from the other STFs. The activities themselves and the joy of doing them is mentioned by every responder and illustrated by this quote selection: 'Develop a lecture demonstration or three, very early on rather than wait a couple of years-there is a lot of fun to be had in doing them (STF 1).' 'Contact the other RSCSTF they will be able to offer suggestions of suitable activities. In fact never reinvent the wheel – always go to them first and if you do create a new resource share, share, share (STF 4).' 'Create resources that suit your personality and your circumstances (STF 2).' The academic's approach to developing activities has been different to the STFs. Rather than personally developing the activities, they tasked his postgraduates and postdoctoral students with developing the activities. 'So what I task people to do, is come up with [an activity] relevant to the stuff you are doing and try to make it more interesting than the benchmark [Bristol ChemLabS lecture demonstration 'A Pollutant's Tale' [30]].' He challenges his students to start with what's already been created and develop something novel.

4. Discussion

While STF's letters to themselves focus on relationships to a large extent, the general focus of the STFs is on relationships within the HEI. Some of these relationships being challenging is the common issue amongst all responders. For every STF it is clear that there were (and still may be) people within the HEI who are not supportive and that they had some challenges settling in to their position and not feeling like their role was clearly defined and understood. While these relational challenges are acknowledged, the overall joy of being able to do and share something that they love, and positively impact children is enough to overcome these challenges. The STFs are enthusiastic about their jobs and the impact they have had. The PAS and academic have experienced the same challenges which suggests that these challenges are not due to the fact that STFs are teachers rather than academics. Rather, the challenges must be related to people's perceptions of the value of doing outreach activities. However, from the STF's perspective, the position and power dynamics related to being school teachers in a tertiary academic environment was very real at the start, and required personal growth and time to overcome. While relationships are valued, the STFs tend to expand on relationships within the HEI in their letters, especially their relationships with academics and technicians that are supportive and enable the smooth running of their work. Relationships with teachers in contrast, while they are mentioned by 4 of the 7 respondents, (and if the respondents are limited to the STFs only, then this is 4 out 5) only STF 3 articulates the value of the development of the mutually beneficial relationships between themselves and teachers. The former STF and STF 3 are the only ones who link

the relationship with teachers to sustainability of the programmes they develop and, in the case of STF 3, the longevity of their position itself.

5. Conclusions

Returning to the tentative research questions posed we would conclude the following.

5.1 How does the role and unique position of the school teacher fellow facilitate the interaction of secondary and tertiary institutions?

The role and unique position of the School Teacher Fellow facilitates positive interactions between secondary and tertiary institutions. If HEIs were more aware of the vital role these relationships between secondary and tertiary institutions play, greater impact would be observed. For example, by ensuring repeat outreach engagements and developing long term partnerships between schools and HEIs, far greater and deeper engagement would result. More time and appropriate (effective) resources would be given to developing and sustaining them. These relationships take time to develop and thus HEIs should invest in continuity in their forward-facing outreach staff. The personal nature of these links are both the greatest strength of this kind of outreach, and potentially the greatest weakness as when staff leave or are promoted the relationships will break down and so continuity and renewing of the links is essential. Sustainability relies on relationships and this means outreach practitioners and HEIs need to invest in people in order to impact large numbers of school students year-on-year, especially at key points in their educational careers. HEIs can use the unique position of the STF to reach and engage teachers more effectively, especially if they take care to protect STFs' time and ensure they are not overloaded with the mundane and administrative tasks.

5.2 How is the role perceived by the school teacher fellows themselves?

STFs in general feel they are in a very privileged position, where they are able to do what they love, i.e. teach their subject, with resources that are not available to them in secondary schools. They have opportunities to develop their own knowledge and skills and are free from the trappings of secondary school teaching (e.g. marking, examination preparation etc.). They see enormous potential in the role not only to develop strong and effective links between secondary schools and higher education institutes and to enthuse and engage school students but to reinvigorate and support secondary school teachers. The role will have challenges that are institution specific but the main one is establishing a strong positive relationship with their host department and being empowered and supported by the senior management. Where this has been the case the STFs have been very successful in their endeavours.

References

[1] Harrison, T.G., Norman N.C. and Shallcross, D.E., (2016), What can be learnt from the Bristol ChemLabS centre for excellence in teaching and learning 10 years on? Timothy Harrison. *Education in Chemistry*, March 2016, 27-29.

[2] University of Bristol, The College of School Teacher Fellows: http://www.chemlabs.bris.ac.uk/collegeofschoolteacherfellows.html [cited 14/03/2016].

[3] Shallcross, D.E., Harrison T.G., Read D. and Barker N., (2014), *On the Impact of School Teacher Fellows in Chemistry Departments within UK Higher Education Institutes, from 2005-2013*, Higher Education Studies, 4(4): 7-17.

[4] Shallcross, D.E. and Harrison T.G., (2007), *A Secondary School Teacher Fellow within a university chemistry department: The answer to problems of recruitment and transition from secondary school to University and subsequent retention?*, Chemistry Education Research and Practice, 8: 101-104.

[5] Shallcross, D.E. and Harrison T.G, (2007), *The Role of the School Teacher Fellow*, Chemistry Education Research and Practice (CERP), RSC, 8 (1).

[6] Shallcross, D.E., Harrison, T.G., Obey, T., Croker, S.J., Norman, N.C. (2013), *Outreach within the Bristol ChemLabS CETL (Centre for Excellence in Teaching and Learning)*, Higher Education Studies, 3, 39-49.

[7] Shallcross, D.E., Harrison, T.G., Norman, N.C., Croker, S.J., (2013), *Lessons in effective Practical Chemistry at tertiary level: Case studies from the Bristol ChemLabS Outreach Program*, Higher Education Studies**,** 3, 1-11.

[8] Braund, M., Hames, V., (2005), Improving progression and continuity from primary to secondary science: Pupil's reactions to bridging work. *International Journal of Science Education*, 27, 781-801.

[9] Braund, M., Driver, M., (2005), Pupil's perceptions of practical science in primary and secondary school: implications for improving progression and continuity of learning. *Educational Research*, 47, 77-91.

[10] Jarman, J., (1997), Fine in theory: a study of primary-secondary continuity in science, prior and subsequent to the introduction of the Northern Ireland curriculum. *Educational Research*, 39, 291-310.

[11] Reay, D., Davies, J., David, M., Ball, S.J., (2001), Choices of degree or degree of choice? Class, 'race' and the higher education choice process. *Sociology – The Journal of the British Sociological Association*, 35, 855-874.

[12] Shaw, A.J., Harrison, T.G., Croker, S.J., Medley, M., Sellou, L., Shallcross, K.L., Williams, S.J., Shallcross, D.E., (2010), University-School partnerships: On the impact on students of Summer Schools (for school students aged 17-18) run by Bristol ChemLabS. *Acta Didactica Napocensia* **3**(4) 35-48.

[13] Steele, L., (2007), Outreach: Ms Libby Steele, Manager, Professional Education and Development, Royal Society of Chemistry, in *Bristol ChemLabS CETL Interim Review 2005-2007*. Bristol ChemLabS, Bristol University: Bristol.

[14] Lord, P., Straw, S., Springate, I., Harland, J., & Hart, R. (2008*). Evaluation of Chemistry for Our Future Report on the first year of the evaluation (2007-2008).* National Foundation for Educational Research, UK.

[15] Tunney, J. (2009). A legacy for chemistry education. *New Directions in the Teaching of Physical Sciences*, 5, 7-11.

[16] Harrison, T.G., Davey, W., Shallcross, D.E., (2011), Making better and wider Use of Undergraduate Teaching Laboratories in the UK. *New Directions in the Teaching of Physical Sciences*, Higher Education Academy UK Physical Sciences Centre, 7, 79 – 84.

[17] Tuah, J., Harrison, T.G., Shallcross, D.E., (2009), The advantages perceived by schoolteachers in engaging their students in university-based chemistry outreach activities. *Acta Didactica Napocensia*, **2** (3), 31-44.

[18] Harrison, T.G., Shallcross, D.E., (2010), What should be Expected of Successful Engagement between Schools, Colleges and Universities?, *School Science Review*, 91(35), 97-102.

[19] Harrison, T.G., Shaw, A.J., Shallcross, K.L., Williams, S.J., Shallcross, D.E., (2010), School-University partnerships: Lessons learned from 10 years of Spectroscopy for Teachers and Post 16 Students. *New Directions in the Teaching of Physical Sciences*, Higher Education Academy UK Physical Sciences Centre, **6**, 72-76.

[20] Shaw, A.J., Harrison, T.G., Croker, S.J., Medley, M., Sellou, L., Shallcross, K.L., Williams, S.J., Shallcross, D.E., (2010), University-School partnerships: Polymer Chemistry days run at a University for 14-15 year olds and their impact on attitudes to Science. *Acta Didactica Napocensia* **3**(1), 19-26.

[21] Shaw, A.J., Harrison, T.G., Shallcross, D.E., (2010), What Value has Chemistry Outreach by a University department to secondary schools? Teacher Perceptions of Bristol ChemLabS Outreach Events. *Acta Didactica Napocensia* 3(3), 15-23.

[22] Shaw, A.J., Harrison, T.G., Shallcross, K.L., Williams, S.J., Shallcross, D.E., (2011), On the impact of the Bristol ChemLabS' Outreach program on admissions to the School of Chemistry. *New Directions in the Teaching of Physical Sciences*, Higher Education Academy UK Physical Sciences Centre, 7, 22 -26.

[23] Braun, V. and V. Clarke, (2006), Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.

[24] Cohen, A., (2007), An examination of the relationship between commitments and culture among five cultural groups of Israeli teachers. *Journal of Cross-Cultural Psychology*, 38(1), 34-49.

[25] Silverman, D., (2001), *Interpreting qualitative data: Methods for analysing talk, text and interaction*. 2nd ed., London: Sage Publications Ltd.

[26] Gibbs, G.R., (2007), *Analyzing qualitative data*, London: Sage Publications.

[27] Miles, M.B., Huberman, A.M., (1994), *Qualitative data analysis: An expanded sourcebook*, 2nd ed., Thousand Oaks, CA: Sage.

[28] Glover S.R., (2016), *It's Not Just About The Kids: The Effects Of University-Led Outreach on Teachers and the Role of the School Teacher Fellow*, PhD Thesis, University of Bristol.

[29] Stem Ambassadors, http://www.stemnet.org.uk/ambassadors/ [cited 14/03/16].

[30] Shallcross D.E., Harrison T.G., Rivett A.C. and Tuah J., (2012). Climate Change: Outreaching to School Students and Teacher', 2029-2075) in '*Handbook of Climate Change Mitigation*', Chen, W.-Y.; Seiner, J.; Suzuki, T.; Lackner, M. (Eds.), Springer Reference.

Authors

Sarah R. Glover, Formerly of the School of Chemistry, University of Bristol, UK.

e-mail: S.R.Glover@bris.ac.uk

Timothy G. Harrison, School of Chemistry, University of Bristol, UK.

e-mail: t.g.harrison@bris.ac.uk . Communicating Author

Dudley E. Shallcross, School of Chemistry, University of Bristol, UK.

e-mail: d.e.shallcross@bris.ac.uk. Communicating Author

Acknowledgement

We thank Bristol ChemLabS under whose auspices this research was undertaken and supported. Professor Shallcross thanks the HEA for a National Teaching Fellowship.